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AN EDGE DETECTION BASED ON IMAGE FUSION ALGORITHM

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Abstract

Edge detection is a part of image segmentation. It is important in digital image processing. The canny edge detector in multi-resolution is not suitable because edge detection is done using only one scale. To over-come this problem we can use wavelet transform for edge detection but this method give poor result in noisy image. We can improve this result by the edge detection based on image fusion method. In this method low frequency information is done with canny detector and high frequenecy information is done with wavelet transform. This method is not only removing the noise but also enhance an edge.

Keywords: edge detection, wavelet transform, canny operator, denoising algorithms, fusion rule**.**

1. Introduction

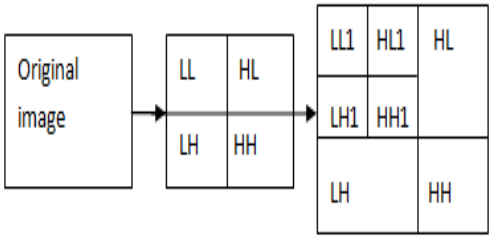
Edge detection method is important in digital image processing because it gives the information of shape of object and analysis the object in image segmentation. There are various type of edge detection method based on first order and second order edge detector. A one of the best method of classical approach edge detector is canny edge detector method.

The advantage of canny edge detector method are given below

It is using probability for finding error rate,. Localization and response improving signal to noise ratio. The disadvantage of canny are complex computational, flase zero crossing and it is not suitable for multi resolution image. The over come to this problem we can use the wavelet transform for detecting an edges but it gives poor result in an noisy image. To avoid this problem we proposed to the method based on edge detection using image fusion. In this method we have decompose an image into low and high region. An edge of low region can be detected with canny operator and high region detected with wavelet transform after denoise the high part of image. Then both sub image edges are fused using fusion rule.

2. Image decomposition based on wavelet transform

This method the original image divided into two parts one is low frequency information and other is high frequency information. After two-dimensional frequency decomposition of wavelet transforms, low frequency area LL and high frequency area HH. Futher high frequency information can be decomposed low frequency area HL and high frequency area HH.



LL is indicating the smoothing image of original image which consist the most information of original image. The LH preserves the vertical edge details. HL preserves the horizontal edge details. HH preserves the diagonal details which are influenced by noise greatly.

3. Fusion algorithm of edge detection combining canny operator with wavelet transform

Though the edge extracted by wavelet transform can reduce the most noise of the image, the real edges of the image are also mixed with much noise, especially HH areas are affected by the noise greatly. Thus many methods of edge detection will discard these HH areas [5]. The four areas obtained from two –dimensional decomposition of wavelet transform contains the useful information of the original image, so these area should be used completely when detecting the image edges. This paper presents a new fusion algorithm based on canny operator and wavelet transform to detect image edges, which can reduce the noise and obtain the continuous and distinct edges.

3.1. Low frequency sub – image edge detecting based on canny operator

The LL area shows the smoothing image of original image which contain the most information of original image. Canny operator is a edge detecting operator based on

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optimal algorithm which has the most stringent criterions of edge detecting. There are some step involve in this process given below:-

3.1.1. Smoothing image- In this step we can use 5×5 gaussian function with convolving the original image function. It gives the smoothing images are shown below;-

I*(x,y)= I(x,y)*M(x,y)

Where the pixel value of the low frequency sub image is I(x,y), M is the gaussain function and I*(x,y) is the smoothed image.

3.1.2. Computing gradient direction and amplitude: - In this step we can compute the gradient direction and amplitude of smoothed image I*(x,y).

3.1.3. Gradient image with non maximum suppression:-In this step when the gradient amplitude of the pixel is not less than the gradient amplitude between two adjacent pixel in gradient direction then the pixel can be judged as the edge point.

3.1.4 Dual threshold method of detecting and connecting the edges:- In this step we can select the two thresholds one is high threshold and other is low threshold to the gradient image.

Through adopting the canny operator to detect the low frequency sub- image can obtain clear edge image which will miss some real edge. Thus the edge of high frequency sub-image should be fused.

3.2. Denoising algorithm of the high frequency sub image based on wavelet transform

When the wavelet coefficient which have smaller amplitude then they carry most noise part and wavelet coefficient which have large amplitude that carry the details of image. In this process the wavelet coefficient is multiplied by the denoising factor.this denoising factor is less than 1. It is decreased when the absolute value of wavelet coefficient is increased.

$$F(X,Y) = \begin{cases} w(x,y) & |\, w(x,y) \geq 3\sigma \,| \\ 0 & |\, w(x,y) \leq |m| \,| \\ w(x,y) \times k & \text{else} \end{cases}$$

Where w(x,y) is the high frequency coefficient, F(X,Y) is the high frequency coefficient gained after denoissing, σ, m show the variance and mean of high frequency coefficient. K is a function is which is relative to the index given below:-

$$K = e^{(-aw(x,y)+b)-1}$$

When $w(x,y) \geq 3\sigma$ then k is equal to 1.

$e^{(-3\sigma(a+b)-1} =1$

when $w(x,y) \leq m$ then k is equal to zero.

$e^{(-a(m)+b)-1=0}$

solve this equation we get the value of a and b given below:-

$a = (-\ln 2) / 3\sigma - m$

$b = a\,(aver)$

put the value of a and b in the equation (1) to get the value of

$k = e^{((-\ln 2 /3\sigma - m)* w(x,y)+(-\ln 2 /3\sigma - m) * m)-1}$

this algorithm is aiming for the wavelet coefficients multiplied by different denoising factoes from different wavelet decomposition levels and different high frequency sub image which can reduced the image noise and keep useful details

3.3 Edge detecting of denoisising high frequency sub image based on wavelet transform:-

This process edge detected of high frequency of sub image after denoising of high frequency sub image using wavelet transform. We can use the wavelet modulus maxima algorithm. It can be describe multiscale edge of the target in image which has translation, scale and rotation- invariant performance. It is effective algorithm to detect the edges

.

The gradient module in scale s is

$M1 f(x,y) = \sqrt{|Ws1 f(x,y)|2 + |Ws2 f(x,y)|2}$

The angle in scales is

$As f(x,y) = \arctan [Ws2 f(x,y) / Ws1 f(x,y)]$

Detecting the edges of the high frequency sub image LH, HL,and HH using wavelet modulus maxima algorithm. Computing the local modulus maxima of three sub images after wavelet transform using equation then their edge images G_LH, G_HL and G_HH will be obtained.

3.4 Fusion algorithm based on wavelet transform:-

This process we can combine the sub image edge by using image fusion rule based on wavelet transform

4. Experiment result:-

We can see that the proposed algorithm is remove the noise but also increased the edges of the image.

Figure 1: Original image

Figure 2: Canny edge detection

Figure 3: wavelet edge detection

Figure 4:proposed algorithm

Figure 5:Original image

Figure 7:wavelet edge detection

Figure 6: canny edge detection

Figure8:proposed algorithm

Figure 9:guassain noise image

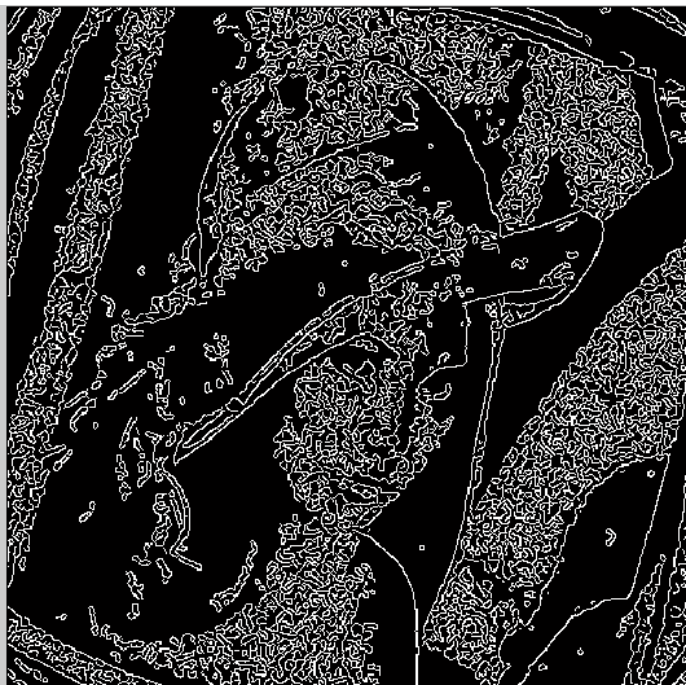

Figure 10:canny edge detection with noisy image

Figure11:wavelet edge detection with noisy image

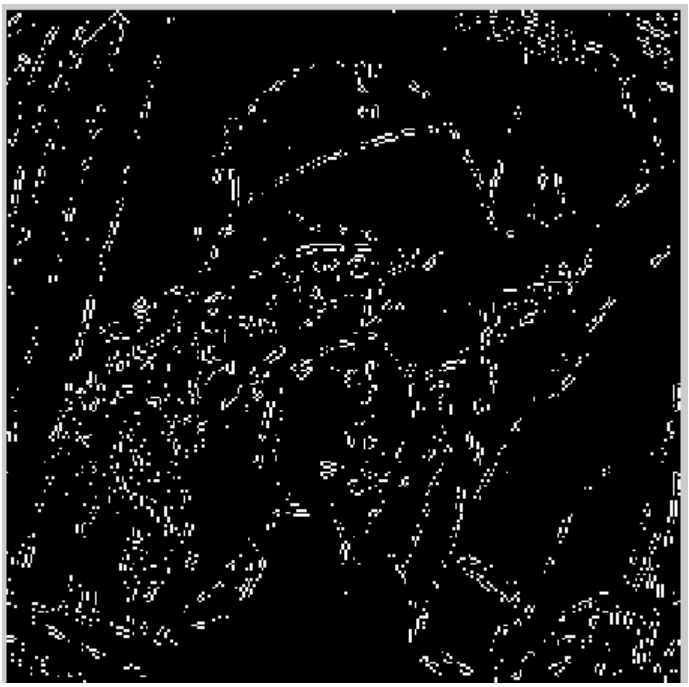

Figure12:proposed algorithm with noisy image

5. Conclusion:-

The classic methods of edge detection give very poor result in high frequency with noise. To deal with this problem we can use the edge detection based on image fusion algorithm. This algorithm not only removes the noise in high frequency region but also enhance the edge of image.

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